CLAIMS

What is claimed is:

1. A method of patterning a magnetic thin film, comprising:

using a chemical transformation of a portion of the magnetic thin film to transform said portion to be non-magnetic and electrically insulating.

2. The method of claim 1, further comprising:

using photolithography to provide a mask over said portion of the magnetic thin film to be preserved.

3. The method of claim 2, further comprising:

converting said portion of said magnetic thin film by a reactive plasma.

4. The method of claim 1, wherein said using said chemical transformation comprises using a fluorine-based reactive plasma.

5. The method of claim 4, wherein said fluorine-based reactive plasma comprises any of NF_3, CF_4, SF_6, CHF_3.

6. The method of claim 3, wherein a pressure used in said converting is within a range of about 10 mT to about 30 mT.

7. The method of claim 3, wherein said portion of said magnetic thin film comprises any of Permalloy™, and alloys of nickel, iron, and cobalt, and said converting comprising converting said any of Permalloy™ and alloys of nickel, iron, and cobalt, to a fluorine-containing film.

8. The method of claim 7, wherein said fluorine-containing film is non-ferromagnetic.

9. The method of claim 7, wherein said fluorine-containing filmis non-magnetic.

10. The method of claim 7, wherein said fluorine-containing film is electrically insulating.

11. The method of claim 2, wherein said mask comprises a photoresist.

12. The method of claim 2, wherein said mask comprises a hard mask patterned layer comprising one of diamond-like carbon (DLC), TiN, and TaN.

13. The method of claim 1, further comprising:

producing a functioning magnetic device.

14. The method of claim 1, wherein said using said chemical transformation is performed at room temperature.

15. The method of claim 3, wherein said reactive plasma includes a fluorocarbon.

16. The method of claim 3, wherein said reactive plasma includes argon.

17. The method of claim 3, wherein said reactive plasma includes sulfur hexafluoride.

18. The method of claim 3, wherein said reactive plasma includes bromide.

19. The method of claim 4, wherein a pressure is selectively employed for said plasma sputtering such that the magnetic thin film material is substantially free of erosion.

20. The method of claim 3, further comprising:

forming an insulating layer over the converted portion of said magnetic thin film and said mask; and

etching said insulating layer and said mask to planarize an upper level of the mask and the insulating layer.

21. The method of claim 20, further comprising:

selectively etching said mask; and

forming a conductive material over the insulating layer and an area where the mask was selectively etched.

22. The method of claim 3, wherein said mask comprises an insulating hard mask, said method further comprising:

after said converting, selectively etching said insulating hard mask to pattern said insulating hard mask.

23. The method of claim 22, further comprising:

forming a conductive material over an area where the insulating hard mask was etched.

24. The method of claim 3, wherein said reactive plasma includes O_2 and a fluorine-containing gas

25. The method of claim 3, wherein said magnetic thin film includes a magnetic tunnel junction (MTJ), and

wherein after said converting said portion, edges of the magnetic tunnel junction have no exposure to oxygen.

26. The method of claim 25, wherein an edge smoothness of the MTJ is determined by a line edge roughness of the mask.

27. A magnetic thin film, comprising:

a magnetic tunnel junction (MTJ) defined by a surrounding region comprising a fluorinated, non-magnetic, electrically insulating material.

28. The magnetic thin film of claim 27, wherein said fluorinated, non-magnetic, electrically insulating material comprises one of a fluorinated Permalloy™ material and a fluorinated alloy material of any of nickel, iron, and cobalt.

29. A magnetic device, comprising:

the magnetic thin film of claim 27; and

a conductive member coupled to said MTJ.

30. The magnetic device of claim 29, wherein said fluorinated, non-magnetic, electrically insulating material comprises one of a fluorinated Permalloy™ material and a fluorinated alloy material of any of nickel, iron, and cobalt.

31. The magnetic device of claim 29, further comprising:

an insulating layer formed over the fluorinated, non-magnetic, electrically insulating material.